

Atty. Docket No. PPW06-563DS
Serial No: 10/676,645

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Remarks

The present Amendment is filed solely to advance prosecution of the application towards allowance. The claims have not been amended for any reason relating to patentability of the claims as filed on January 22, 2007.

Claim 1 has been amended to include the limitations of claims 2 and 3. Therefore, no new matter is introduced by the present Amendment. Claims 1, 4-5, 8, 22-24, 27-32 and 34-37 are active in this application.

The present invention relates to a semiconductor device comprising:

- a) a via within an insulation layer over a semiconductor substrate;
- b) a barrier metal layer on a surface of the via;
- c) a metal line comprising copper in the via over the barrier metal layer;
- d) a pad in a predetermined region of the metal line; and
- e) an alloy layer on an upper surface of the metal line, wherein a top surface of the alloy layer is coplanar with or lower than a top surface of the insulation layer, and the alloy layer comprises copper and a low melting point metal selected from the group consisting of aluminum, lead, and silver (see Claim 1 above).

The cited references do not disclose or suggest, alone or taken together, a semiconductor device including an alloy layer on an upper surface of a metal line, comprising copper and a low melting point metal selected from the group consisting of aluminum, lead, and silver, where the alloy layer has a top surface that is coplanar with or lower than a top surface of the insulation layer. Thus, the present claims are patentable over the cited references.

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The Rejection of Claims 1-5, 23, 24, 27-32 and 34-35 under 35 U.S.C. § 102(e) or 35 U.S.C. § 103(a)

The rejection of Claims 1-5, 23, 24, 27-32 and 34-35 under 35 U.S.C. 102(e) as being anticipated by or, in the alternative, 35 U.S.C. 103(a) as obvious over Matsubara (U.S. 6,890,852) is respectfully traversed.

Matsubara discloses a layer of copper buried wiring 8 comprising a copper thick film 10 and a copper thin film 9 which maybe made of pure copper or copper alloys (col. 10, ll. 20-22, and Fig. 1). Matsubara does not disclose a semiconductor device including an alloy layer on an upper surface of a metal line, comprising copper and a metal selected from the group consisting of aluminum, lead, and silver. As a result, Matsubara does not anticipate the present Claims 1-5, 23, 26-28 and 30. Thus, the rejection under 35 U.S.C. § 102(e) is not sustainable and should be withdrawn.

The claims clearly recite the structure and composition of the claimed device. The structure comprises a via, a barrier metal layer, a metal line, a pad, and an alloy layer. The composition of the alloy layer comprises copper and a low melting point metal selected from the group consisting of aluminum, lead, and silver. Therefore, the presumption(s) relating to the reaction product previously recited in the present claims is/are moot. As a result, the present Claims 1-5, 23, 26-28 and 30 are patentable over Matsubara. Thus, the rejection under 35 U.S.C. § 103(a) is not sustainable and should be withdrawn.

The Rejection of Claims 5, 8, 21-22, and 31 under 35 U.S.C. § 103(a)

The rejection of Claims 5, 8, 21-22, and 31 under 35 U.S.C. § 103(a) as being unpatentable over Matsubara in view of Liu et al. (US 6,638,867, hereinafter "Liu") is respectfully traversed.

As discussed above, Matsubara fails to teach, disclose or suggest an alloy layer on an upper surface of a metal line, comprising copper and a metal selected from the group consisting

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of aluminum, lead, and silver (see Claim 1 above). Liu fails to cure the deficiencies of Matsubara with regard to Claim 1.

Liu discloses a bonding pad 60 that includes an aluminum alloy bonding pad segment 54 in a shallow interconnection line 40 (see col. 6, ll. 16-27, and FIGS. 6C-6D) and an aluminum conductive layer 58 over the bonding pad segment 54 (see col. 6, ll. 34-42, and FIG. 6C). Liu further discloses that the conductive layer 58 over the bonding pad segment 54 can alternatively consist of aluminum alloy, tungsten, copper, or a copper alloy (see col. 6, ll. 35-40). Aluminum has a melting point below 1000°C., and as a result, the aluminum alloy conductive layer 58 on bonding pad segment 54 could, in theory, be the claimed alloy. However, Liu does not appear to teach or disclose that the non-aluminum metal in the aluminum alloy is copper (see col. 6, ll. 34-40).

Similarly, the copper alloy alternative for conductive layer 58 could be the claimed alloy, but there is no indication in Liu that the copper alloy is an alloy of copper and aluminum (see col. 6, ll. 34-40). Therefore, Liu does not disclose an alloy layer comprising copper and a metal selected from the group consisting of aluminum, lead, and silver.

As a result, Claim 1 (and all claims dependent therefrom, including Claims 5, 8, 21-22, 31 and 34) are patentable over Matsubara in view of Liu, the combination of which fails to teach, disclose or suggest an alloy layer on an upper surface of a metal line, comprising a reaction product of the metal line and a low melting point metal having a melting point less than or equal to 1000°C. Consequently, the rejection of Claims 5, 8, 21-22, and 31 under 35 U.S.C. § 103(a) should be withdrawn.

Conclusions

In view of the above amendments and remarks, all bases for objection and rejection are overcome, and the application is in condition for allowance. Early notice to that effect is earnestly requested.

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If it is deemed helpful or beneficial to the efficient prosecution of the present application,
the Examiner is invited to contact Applicant's undersigned representative by telephone.

Respectfully submitted,



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